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QUERY. "In the Treatise on the elements of Geometry by Rouche′ and Comberoucse, some miscellaneous problems in solid geometry are proposed, among which is the following:—'Draw a sphere which shall cut five other spheres under equal angles.'—Can any reader of the ANALYST refer me to a solution, or if not, give one."

ANSWER BY R. J. ADCOCK.

LET r_1, r_2, r_3, r_4, r_5 be the radii of the given spheres, (x_1, y_1, z_1), (x_2, y_2, z_2), &c., the coordinates of their centres, δ the radius of the required sphere and α, β, γ, the coordinates of its centre. And put $A =$ the angle of intersection. Then the square of the line joining the centres of the spheres r_1 and δ is

$$(x_1-\alpha)^2+(y_1-\beta)^2+(z_1-\gamma)^2 = r_1^2+\delta^2\pm2r_1\delta\cos A; \quad \text{hence}$$

$$\begin{aligned}\pm\cos A &= \frac{(x_1-\alpha)^2+(y_1-\beta)^2+(z_1-\gamma)^2-r_1^2-\delta^2}{2r_1\delta}\\ &= \frac{(x_2-\alpha)^2+(y_2-\beta)^2+(z_2-\gamma)^2-r_2^2-\delta^2}{2r_2\delta}\\ &= \frac{(x_3-\alpha)^2+(y_3-\beta)^2+(z_3-\gamma)^2-r_3^2-\delta^2}{2r_3\delta}\\ &= \frac{(x_4-\alpha)^2+(y_4-\beta)^2+(z_4-\gamma)^2-r_4^2-\delta^2}{2r_4\delta}\\ &= \frac{(x_5-\alpha)^2+(y_5-\beta)^2+(z_5-\gamma)^2-r_5^2-\delta^2}{2r_5\delta},\end{aligned}$$

four equations for the four quantities α, β, γ, δ, which completely determine the required sphere.

PROBLEMS.

175. BY NEWTON FITZ, NORFOLK, VIRGINIA.—Find the roots of the equation

$$x^4 + Ax^3 + Bx^2 + Cx + \frac{C^2}{A^2} = 0.$$

176. BY PROF. ORSON PRATT, SEN., SALT LAKE CITY, UTAH.—Given

$$u = F\ (y), \text{ and } y = F'[z + xvf\ (y)];$$

also

$$v = F_1(t), \text{ and } t = F_2[z + xvf_1(t)],$$

to expand (by the differential calculus) u in a series of ascending, positive and integral powers of x. (x not being a function of z.)

177. By Christine Ladd, Union Springs, N. Y.—If I_1, I_2, I_3 be the points of contact of the inscribed circle with the sides of the triangle ABC, E_1, E_2, E_3 the centres of the escribed circles, r_i the radius of the circle inscribed in $I_1I_2I_3$ and r_e the radius of that inscribed in $E_1E_2E_3$, show that

$$r_i = r.\frac{a+b+c}{\alpha+\beta+\gamma}, \qquad r_e = 2R.\frac{a+b+c}{\alpha+\beta+\gamma},$$

where R and r have their usual values and α, β, γ are the distances between the centres of the escribed circles.

178. By Marcus Baker, U. S. Coast Sur., Wash., D. C.—Through any point O in a plane triangle ABC three lines α, β, γ are drawn parallel to the sides a, b and c respectively; prove that

$$\frac{\alpha}{a} + \frac{\beta}{b} + \frac{\gamma}{c} = 2.$$

179. By Geo. M. Day, Lockport, N. Y.—Integrate

$$\frac{\sin\theta d\theta}{(\sin\theta + \cos\theta)^3}.$$

180. (Selected) By Geo. Lilley, Kewanee, Ill. — Two equal spheres placed in a paraboloid with its axis vertical touch one another at the focus. If W be the weight of a sphere, R, R' the pressures upon it prove that $W^2 : R.R' :: 3 : 2$.

181. By Prof. E. W. Hyde. — Find the volume between $x = 0$ and $x = 2l$ of the solid bounded by the surface whose equation is

$$a(y^4+z^4) - z^2(x^3-2ay^2+2e^3) - y^2(bx^2+c^2x+e^3) = 0.$$

Special Notice.—As is well known to the readers of the Analyst, its publication was undertaken, not with the expectation of gain, but to supply, temporarily, a "medium of communication" between mathematicians and students of mathematics in this country; and it has been, and is, our intention only to continue the publication so long as it will be of service to mathematicians.

Our patronage, so far, has exceeded our anticipations, so that we had no thought of discontinuing the publication at present. But, through the kindness of Prof. Hall, we have just received (Aug. 11th) a *Prospectus* of *The American Journal of Pure and Applied Mathematics,* to be published at Baltimore; and as most of our subscribers will undoubtedly want the new Journal, and many of them may not want to incur the expense of two